(19) Europäisches Patentamt
Europ an Patent Office
Office européen d s brev ts

(11) Publication number: **0 319 180 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 88310956.3

(51) Int. Cl.4: B07C 5/12 , F16H 25/00

(22) Date of filing: 21.11.88

(30) Priority: 02.12.87 US 128357

(43) Date of publication of application: 07.06.89 Bulletin 89/23

(84) Designated Contracting States: DE FR GB IT

(71) Applicant: EMHART INDUSTRIES, INC.
426 Colt Highway
Farmington Connecticut 06032(US)

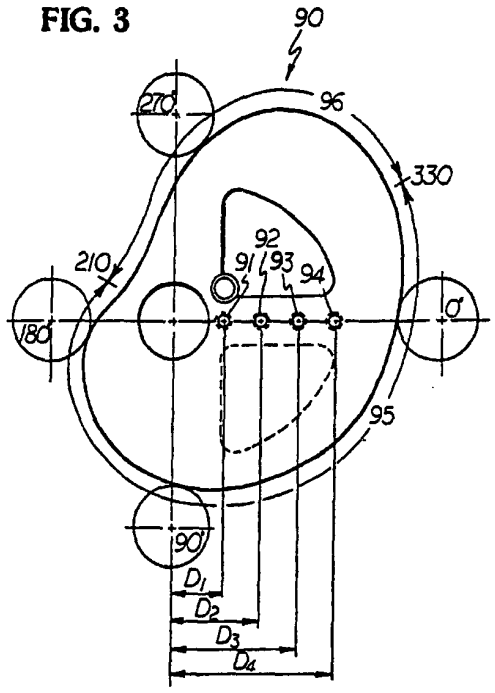
(72) Inventor: Shay, Timothy W.
476 Breesport Road
Horseheads New York 14845(US)

(74) Representative: Randall, John Walter et al
Emhart Patents Department Lyn House 39
The Parade
Oadby, Leicester LE2 5BB(GB)

(54) Improved mechanism for glass container inspection apparatus.

(57) An improved mechanism for coordinating the transport of a glass container through an inspection zone with the movement of an inspection head relative to the container. In a plug gager, a carriage (16) which holds the plug gage (13) is moved in the direction of container travel by a cam (90), while an eccentrically-mounted bearing moves the plug gage vertically to penetrate the container finish. The invention provides an improved cam profile (95) to provide an increased maximum stroke (amount of gage penetration) making the apparatus adaptable to a wider range of container sizes. Relative to prior art cams for apparatus of this type, the constant velocity segment of the cam motion is extended. A similar adaptation to a leak detector utilizing this cam-driven carriage and inspection head arrangement lengthens the segment of each cycle during which inspection occurs, increasing the sensitivity of the system. In a check detector utilizing this arrangement, this improved cam-driven mechanism provides increased inspection speed and accuracy, and allows better stopping of containers at high speeds.

FIG. 3



EP 0 319 180 A2

IMPROVED MECHANISM FOR GLASS CONTAINER INSPECTION APPARATUS

SPECIFICATION

BACKGROUND OF THE INVENTION

The present invention relates to mechanisms for use with automatic apparatus for inspecting glass containers and the like, and more particularly to an improved cam-driven assembly for controlling the motion of an inspection head in coordination with the motion of a container through an inspection zone.

Commonly assigned U.S. Patent No. 3,387,704 to W.S. Powers, Jr., entitled "Aperture Gaging and Sorting Device", discloses improved inspection apparatus of the type commonly termed "plug gagers" wherein, as best seen in Figure 1, the plug gage is mounted to a vertically reciprocating plunger. Having reference to Figures 1 and 4 of that patent and the text discussing these, during each inspection cycle the plug gage plunger is caused to reciprocate through a predetermined vertical travel by means of a bearing member 29 which is eccentrically mounted to cam 24 to slide along horizontal cam track 22. In coordination with this vertical motion, the plug gage plunger assembly is caused to move horizontally in coordination with the motion of bottles through the inspection zone by means of the same cam 24, via a cam follower roller 25 which is maintained in peripheral contact with the cam 24 by biasing means (i.e., springs 26 and 27) which forwardly urge the carriage 16 in which the plunger and cam are mounted. As illustrated in Figure 8 of the '704 patent, the cam 24 includes a linear motion portion (as illustrated, comprising about 180 degrees of the cam) during which equal angular movements of the cam cause equal linear traversing movements of the carriage and plunger. This causes the gage and the article to be inspected to move horizontally in unison during the gaging operation. It is noted that the other portion of the cam has a contour which causes the carriage to be moved back to its starting position taking any suitable form to minimize shock, such as a sinusoidal curve.

Applicants have also manufactured so-called "leak detector" apparatus utilizing the '704 design, i.e. apparatus utilizing a plunger mounted device for injecting air into each container, to monitor the pressure therein for comparison to a standard representing the pressure in a good container. "Fluidic Finish Selector" apparatus of this design is disclosed in commonly assigned U.S. Patent No. 3,496,761.

Commonly assigned U.S. Patent No. 3,557,950 to W. Powers, "Photo-Electric Crack Detector for Glass Bottles", discloses apparatus of the type commonly known as a "check detector" wherein a horizontally mounted plunger 18 and a vertically mounted plunger 34 carry optical sensors to be deployed respectively at the bottom and top of the bottles for detection of checks, as well as pairs of rollers to engage the bottles respectively at the sidewall and finish during rotation and translation of the bottles through the inspection area. Both of these plungers are caused to reciprocate toward and away from the bottle to be inspected, and simultaneously to move horizontally in coordination with the horizontal motion of the bottle through the inspection zone, by means of a carriage and cam assembly of the same type as disclosed in U.S. Patent 3,387,704. A light source is mounted to the carriage for the vertical plunger to illuminate each bottle, and a second light source is located below the bottle path, in order that checks may be detected by the respective optical sensors. During this period, the bottle is grasped between rollers on the one side and belts on the other, as well as the rollers at the finish, to rotate it at least 360 degrees as it passes through the test area. Commonly assigned U.S. Patent No. 3,690,456 to W.S. Powers, Jr., Glass Container Crack Detector, discloses an improvement to the '950 check detector apparatus wherein the apparatus includes a braking assembly at the downstream end of the belts, which assembly causes the container to lose contact with each belt and stop the container from rotating. In commercial check detectors generally in accordance with the '456 patent, the above design has been modified by mounting the optical sensors to the respective carriages so that these move in parallel with the bottles with no transverse motion. In this commercial embodiment only the guide rollers are mounted to the plungers.

The above described carriage-cam-cam follower-plunger arrangement has generally been observed to provide excellent performance in plug gager and check detector apparatus manufactured in accordance with the teachings of the '704 and '950 patents. However, in using a plug gager manufactured in accordance with the '704 preferred embodiment, this apparatus has the limitation that the total vertical travel of the plug gage is limited to twice the offset of the eccentric bearing 29, and the "stroke" or amount of gage penetration is equal to the offset. In effect, the maximum stroke required of such plug gager apparatus dictates the vertical

size of the plug gage carriage and related supports, and in order to achieve more stroke, it is required to replace the entire carriage, cam and support plate with larger assemblies. The use of such larger assemblies undesirably increases the cost of the system and decreases its speed of operation.

Accordingly, it is the principal object of the invention to provide improved plug gager apparatus of the type disclosed in U.S. Patent No. 3,387,704. A related object is to improve the '704 design so as to adapt it to a larger range of container sizes.

A further object is to improve the operation of other types of inspection apparatus using the '704 mechanism for moving the inspection head.

SUMMARY OF THE INVENTION

In furthering the above and additional objects, the invention provides an improved gaging device for glass containers and the like of the type including means for conveying containers past a testing area at a constant linear speed, a reciprocable carriage member, a testing gage mounted on a vertically reciprocable plunger to be inserted in the finish of a container to be tested, a bearing member eccentrically mounted to said cam, said bearing member being mounted to said plunger so that the rotation of the cam causes the vertical reciprocation of the plunger, and a cam follower member which follows the periphery of the rotating cam and is coupled to said carriage to cause the traversing of the carriage and the carriage-mounted plunger in parallel to the conveyance of the container past the testing area during the movement of the testing gage into and out of the finish of the container; wherein the improvement comprises an improved profile of said rotatably mounted cam having an extended linear motion contour occupying substantially more than 180° of the angular profile of said cam. In an operative embodiment of the invention, the improved cam has a linear motion contour occupying about 240° of the cam profile.

In a plug gager apparatus in accordance with the invention, the testing gage which enters the finish of the container and penetrates the container for a predetermined stroke, unless the finish is constricted beyond an allowable tolerance. Preferably, the plug gage enters the finish of the container when the cam follower is located at the beginning of the extended linear motion portion of the cam profile, and leaves the finish at the end of said extended linear motion portion.

In a leak detector inspection apparatus in accordance with the invention, the testing gage comprises a leak detector gage which injects air in the container and monitors the pressure within the container during an inspection interval during which the leak detector gage seals the finish of the container.

In a check detector inspection apparatus in accordance with the invention, such apparatus further comprises a second reciprocable carriage member, a second plunger-mounted testing gage, and a second rotating cam, all oriented so as to horizontally reciprocate said plunger to move the second testing gage into and out of proximity with the bottom of the container while causing the traversing of the second carriage and carriage-mounted plunger in parallel to the conveyance of the container, wherein the first and second testing gages comprise optical sensors for detecting the presence of checks in the neck and at the bottom of said container, respectively. Alternatively, the vertical and horizontal plungers only carry the rollers for engaging the rotating container during the inspection interval, and the optical sensor assemblies are mounted to the respective carriages.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and additional aspects of the invention are illustrated in the following detailed description of the preferred embodiment, which should be taken together with the drawings in which:

Figure 1 is a simplified front elevation view of plug gager apparatus in accordance with the design generally disclosed in U.S. Patent No. 3,387,704, incorporating the improved drive cam of the present invention:

Figure 2 is a rear view of the prior art cam of U.S. Patent No. 3,387,704 showing selected positions of the carriage traversing cam follower;

Figure 3 is a rear view of the improved cam of the present invention, incorporated in the apparatus of Figure 1, showing selected positions of the cam follower corresponding to those shown in Figure 2; and

Figures 4A and 4B schematically illustrate the relationship between cam rotation and plug gage stroke, for the prior art cam of Figure 2, and the improved cam of Figure 3, respectively, as seen from the front.

DETAILED DESCRIPTION

Reference should now b had to Figure 1 for a discussion of plug gager apparatus incorporating an improved drive cam in accordance with the

present invention.

Figure 1 is a simplified view of the aperture gaging (plug gager) apparatus disclosed in U.S. Patent No. 3,387,704 corresponding to Figure 1 of this patent. As discussed above, the vertical motion of the plunger and plug gage is determined by the motion of the eccentrically mounted bearing roller 23 which is secured to plunger 18 by yoke 29, while the horizontal motion of the carriage 16 relative to the support plate 60 is determined by the motion of cam follower 25 against the periphery of cam 24. Containers to be tested are brought by screw conveyor 54 into position where the necks of the bottles are directly below the plug gage 13 at the time that cam 24 has positioned the carriage 16 at the limit of its rearward movement, and the gage is in its mid-stroke position poised above the neck of the bottle as shown in Figure 1. As the cam 24 and screw conveyor 54 are rotated in timed relation from a power shaft (not shown), the carriage 16 and the container in the gaging position travel in synchronism, and the gage is thrust into the neck of the bottle and then withdrawn during this lateral movement in unison. Reference should be had to U.S. Patent No. 3,387,704 for details of the operation of plug gager apparatus 10.

The prior art apparatus of U.S. Patent No. 3,387,704, provided 180° of constant velocity to match the travel of container 11, and 180° of return motion. Reference should be had to Figure 2 hereof which illustrates the prior art contour of cam 24, generally in accordance with Figure 8 of the '704 patent. Cam 24 includes a linear motion contour extending from the 0° position to the 180° position (two of the four cam follower positions shown in Figure 2). The remainder of the cam profile, from 180° to 0°, comprises a sinusoidal return contour. The motion of the plug gage into and out of container 11 is determined by the offset of eccentrically mounted bearing roller 23. In the cam 24 of Figure 2, there are four possible mounting positions 71-74 for roller 23, corresponding to offset distances D_1-D_4 respectively equalling .75", 1.5", 2.125", and 2.75". Now having reference to Figure 4A, which is a front view of the prior art cam 24 of Figure 2 illustrating plunger stroke, the plunger enters the neck of the bottle at the 0° position 81, reaches its bottom dead center position at 82, and exits the bottle at 83. Therefore, the total stroke X_1 (maximum plug gage penetration) is equal to the offset 2.75" of the roller 23.

Reference should now be had to Figure 3 which illustrates an improved cam profile in accordance with the present invention, to be substituted for the cam 24 of Figure 2. Cam 90 includes an extended constant velocity or linear motion portion 95 which commences at the 330° cam follower position and continues until the 210° cam follower position, a total of 240° as compared with 180° in the cam 24 of Figure 2. The remainder 96 of the cam profile, from 210° to 330°, is cycloidal in form, although contours of any suitable form designed to minimize shock could be employed. The effect of this extended linear portion 95 of the cam profile is illustrated in Figure 4B. The plug gage 13 begins to enter the bottle finish at the beginning of the constant velocity portion (eccentric bearing roller position 97), which in this case is at the 330° point, 30° sooner than for the cam 24 of Figure 4A. Similarly, the plug gage exits the bottle at the 210° point (roller position 99), 30° later than in the prior art cam 24 of Figure 4A. The resulting increase in stroke illustrated in Figure 4B equals R sin(30°), where R equals the eccentric offset. By this formula, an extension of the constant velocity portion of the cam gives a new stroke which is 1.5 times greater than the old stroke (this is the vertical separation of the bearing positions 97, 99 from the bottom dead center position 98). For eccentric mounting positions 91-94 (Figure 3) equivalent to the mounting positions 71-74 shown in Figure 2, this results in a maximum stroke X_2 equal to 4.125" compared with the 2.75" maximum stroke of the prior art. This is achieved without requiring a considerably larger cam, carriage, etc. as was the case in the prior art.

The improved cam 90 of the invention provides significant advantages in other types of container inspection apparatus utilizing this carriage mounted cam-plunger arrangement. One such instance is the leak detector apparatus shown in Figure 1 of commonly assigned U.S. Patent No. 3,496,761, which patent is incorporated herein by reference. The "fluidic finish selector" disclosed in Figure 1 of the '761 patent incorporates a cam 22, eccentrically mounted bearing 26, and cam follower 23 to control the motion of a carriage 8 and plunger tube 12 much as in the plug gager of U.S. Patent No. 3,387,704. A test fitting 13 at the end of plunger tube 12 closes the mouth of the container under test during a portion of each cycle in which it is lowered to seal the container finish due to the downward movement of plunger tube 12. During this inspection interval, the device injects a predetermined volume of air into the container, and at the end of this interval, the pressure within the container is measured to detect the presence of leaks, i.e., whether the pressure falls below a predetermined minimum. By substituting for the prior art cam (with 180° linear motion contour) an improved cam such as the cam illustrated in Figure 3 hereof, the duration of the inspection interval is increased, increasing the maximum permissible leakage (pressure differential) which could be measured. This improves the sensitivity of the fluidic finish selector.

In another application of the ext nded-linear-contour cam of Figure 3, this cam is substituted in the carriage-cam-plunger assemblies of the "photoelectric crack detector" of U.S. Patent No. 3,690,456, the disclosure of which is incorporated by reference herein. With particular reference to Figure 1 of the '456 patent, two cam-carriage-plunger assemblies of the type previously described, respectively including vertical plunger 28 and horizontal plunger 18, control the motion of roller-optical sensor assemblies in parallel with the linear conveyance of container 15, as well as transverse motion of the assemblies into and out of engagement with the container finish and bottom, respectively. In addition, a light source assembly to illuminate the finish of the container is mounted to the carriage for the vertical plunger, and a light source to illuminate the bottom of the container is located below the container path. Linear transport of the container through the inspection site is achieved by engaging the container between endless belt 24 and rollers 16; in addition, plunger-mounted rollers 38, 40 engage the bottle finish. At the end of the inspection interval, container rotation is halted by brake pads 23 which protrude beyond the surface of belt 24. By incorporating improved cams such as the cam 90 of Figure 3 hereof, the duration of the inspection interval is increased, which permits the bottle to be turned through more rotations at a given speed, improving inspection accuracy. This also increases the container's exposure to brake pads 23, allowing better braking at high transport speeds.

In an alternative check detection apparatus generally in accordance with the above-described improvement to the apparatus of U.S. Patent No. 3,690,456, the plungers 18, 28 only carry roller assemblies for engaging the bottle during inspection, and the optical sensor assemblies are mounted to the respective carriages whereby these move in parallel with the container with no transverse motion. Incorporation of the improved cam of Figure 3 hereof in such apparatus provides the same advantages as are described in the paragraph immediately preceding.

Claims

1. An improved gaging device for glass containers and the like of the type including means (54) for conveying the containers past the testing area at a constant linear speed, a reciprocable carriage member (16), a testing gage mounted on a vertically reciprocable plunger (18) to be brought into engagement with the finish of a container to b tested, a cam (90) rotated around a horizontal axis of rotation, a bearing member (23) eccentrically mounted to said cam (90), said bearing member (73) being mounted to said plunger (18) so that the rotation of the cam (90) causes the vertical reciprocation of the plunger (18), and a cam follower member (25) which follows the periphery of the rotating cam (90) and is coupled to said carriage (16) to cause the traversing of said carriage (16) and carriage-mounted plunger (18) in parallel to the conveyance of the container (54) past the testing area during the movement of the testing gage into engagement with the finish of the container, wherein the improvement comprises

an improved profile of said rotatably mounted cam having an extended linear motion contour (95) occupying more than 180° of the angular profile of said cam (90).

2. Apparatus as defined in claim 1, wherein the improved cam has a linear motion contour (95) occupying about 240° of the cam profile.

3. Apparatus as defined in claim 1 wherein the testing gage comprises a plug gage (13) which enters the finish of the container and penetrates the container for a predetermined stroke, unless the finish is constricted beyond an allowable tolerance.

4. Apparatus as defined in claim 3 wherein the plug gage (13) enters the finish of the container which the cam follower is located at the beginning of the extended linear motion portion of the cam contour (95), and leaves the finish at the end of the said extended linear motion portion (95).

5. Apparatus as defined in claim 1 wherein the testing gage (13) is a leak detector gage which injects air in the container and monitors the pressure within the container during an inspection interval during which the leak detector gage seals the finish of the container.

FIG 1
PRIOR ART

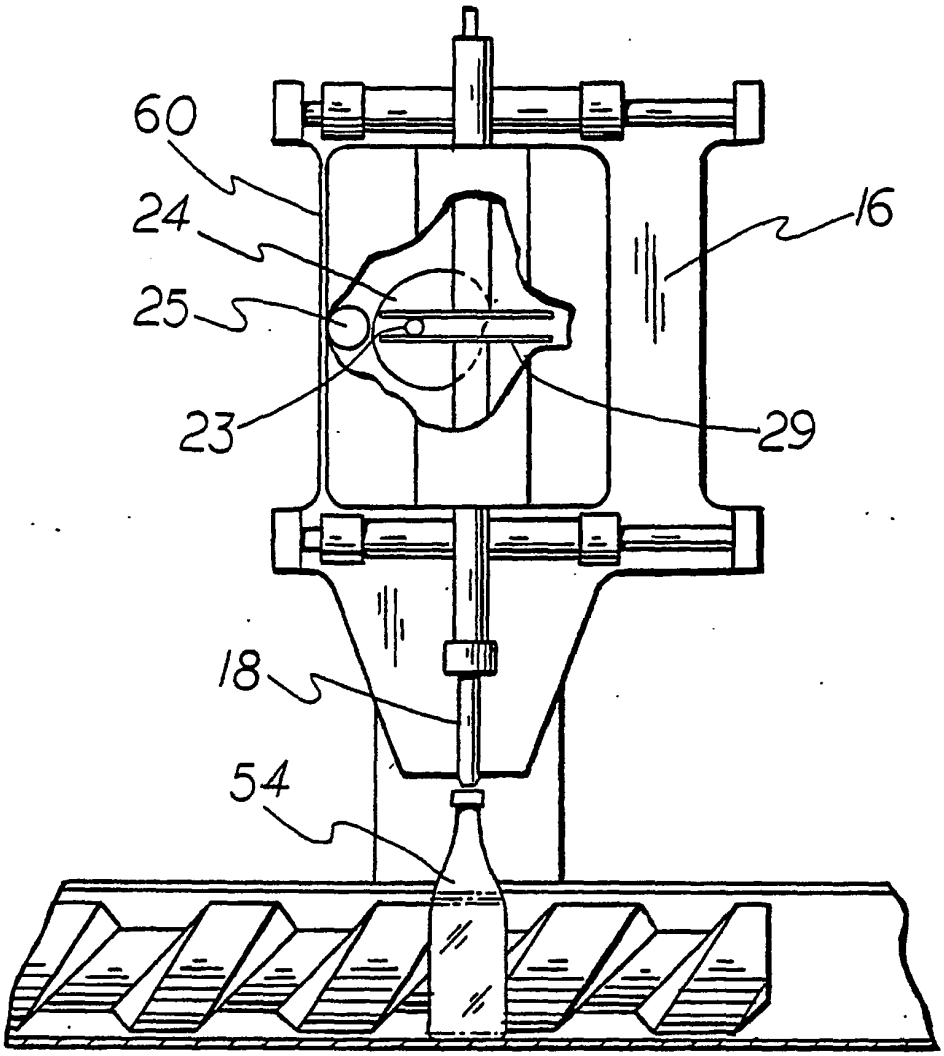


FIG. 2
PRIOR ART

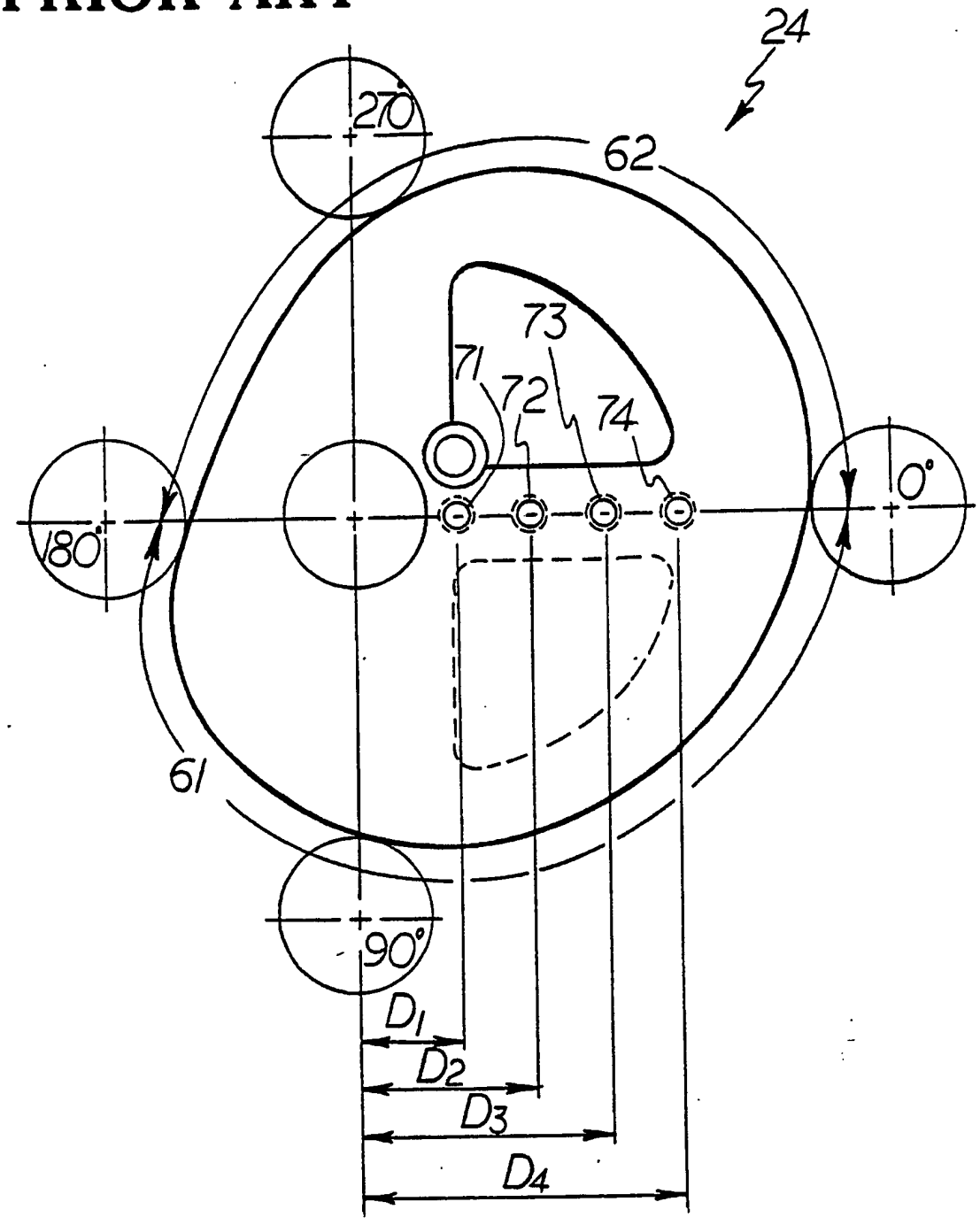


FIG. 3

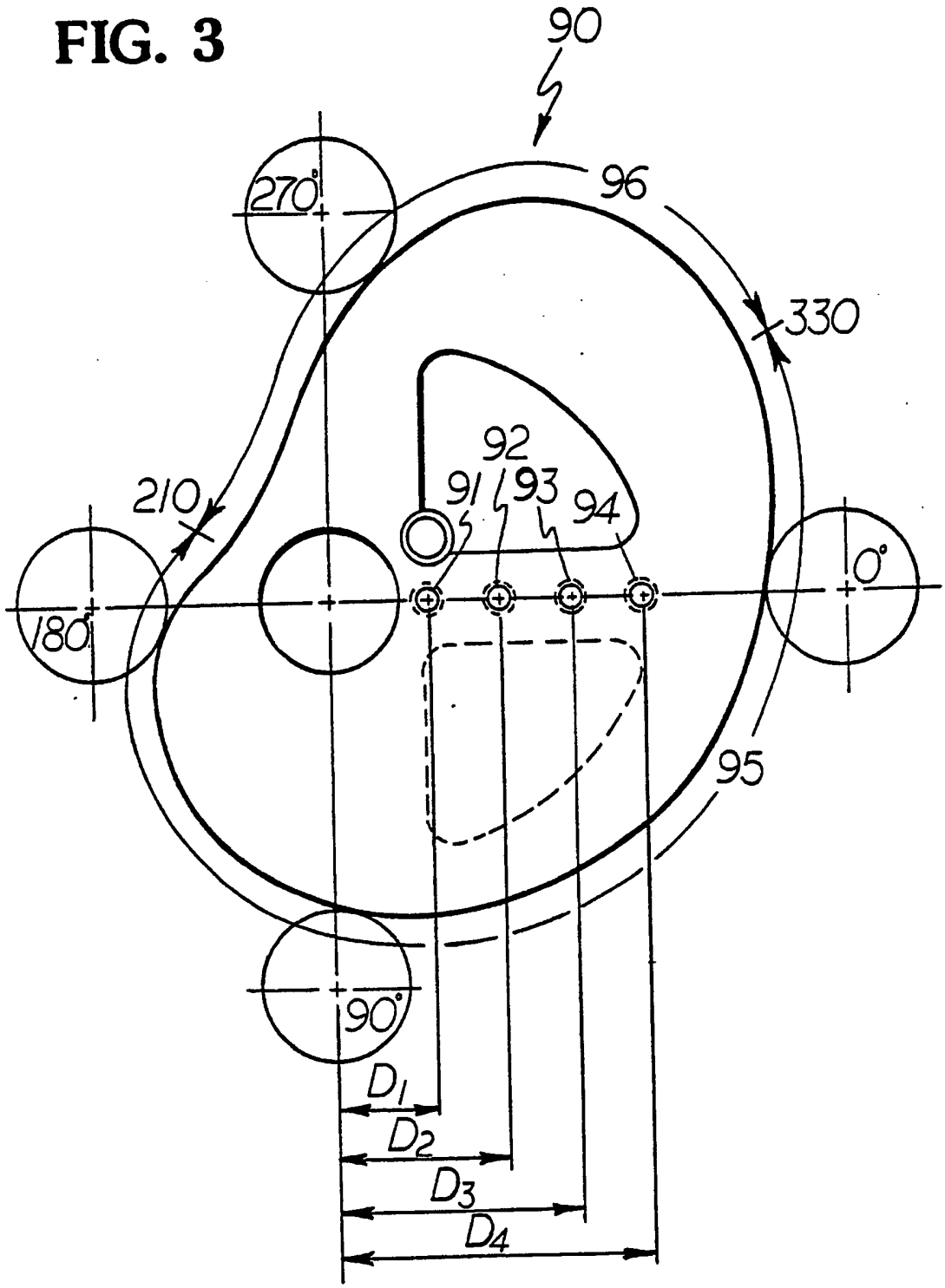
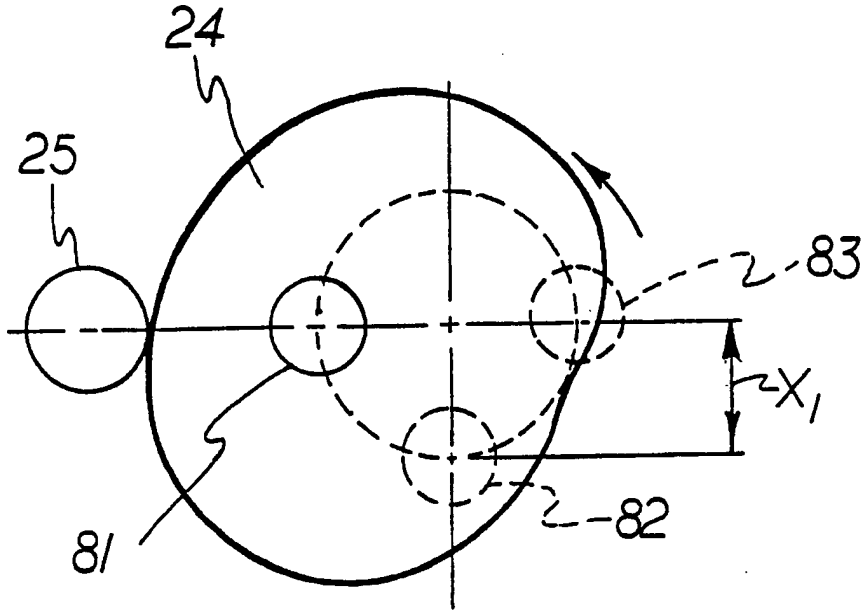


FIG. 4a



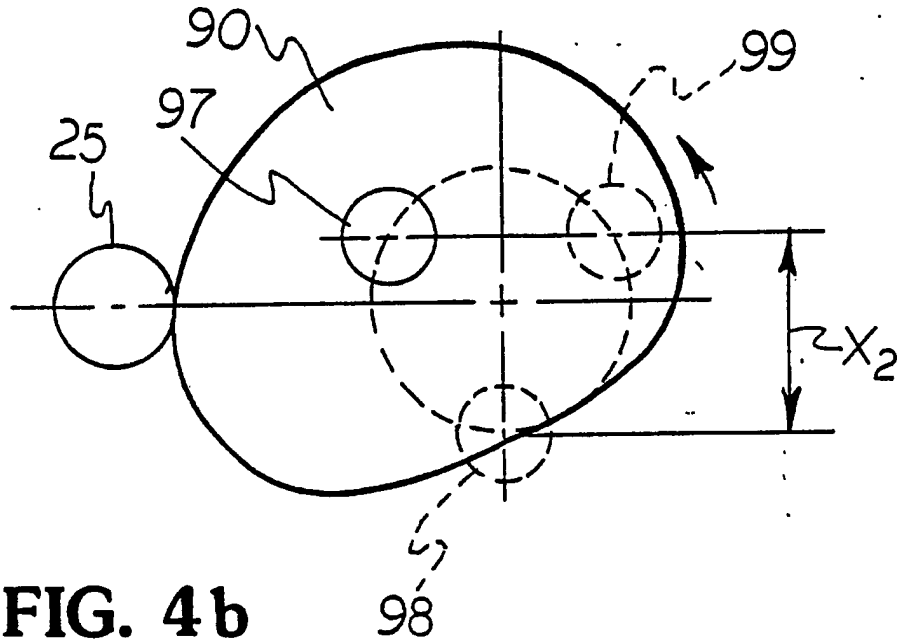


FIG. 4b